Observations upon the Relationships of the (Bryozoa) Selenariadæ, Conescharellinidæ, etc., Fossil and Recent.

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(Plates 29, 30.)

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* In preparing a list of Bryozoa from Oran (Algiers) a few specimens of *Cupularia Johnsoni*, Busk, have led me to more extended studies for a better understanding of the whole of the group ; however, a large number of spirit or fresh specimens are required for a complete study of this little understood group, which is one of the most interesting. This communication makes no pretension to dealing exhaustively with it, being principally remarks on some species in my collection.

I had previously received, from the late Canon Norman, a few spirit specimens of three species of *Cupularia*, collected off Madeira, namely, *C. canariensis*, Busk, *C. Johnsoni*, Busk, *C. Lowei*, Busk, each of which revealed new structures, in stained preparations and sections.

Of what have been considered as Selenariadæ all are more or less cup-shaped or flat, and though now the shape alone would not be considered

* Shortened references are used in the text for the sake of economy, and the explanations of these contractions are given on p. 409.

sufficient for classification, yet it is important to see how far other characters run through all or most species.

The basal * structure of *Cupularia canariensis* has a series of parallel chambers (Pl. 29. fig. 1) filled with a granular substance and having a connection from each chamber to its neighbours through rosette-plates. The lateral walls are parallel with the axis of the zoarium. These chambers are partly shown by Busk in his *L. canariensis*, 'Crag Polyzoa,' pl. 2. fig. 2 *e*, and would have been called kenozoœcia by the late Professor Levinsen, while Reuss and others have named the chambers at the base of *Batopora* "abortive cells." In *Cupularia* the walls of these chambers, as well as those of the zoœcial and vibracular chambers, are lined by large square flat cells with a small nucleus (Pl. 29. figs. 2 & 3). These large cells seem to occur generally in the Selenariadæ.

In *C. Lowei*, Busk, looking at decalcified and stained preparations, with the opercular wall in focus, a number of small bundles of muscles are seen, which pass from the frontal membrane through the large frontal calcareous pores (Pl. 30. fig. 1). Similar muscles occur generally in the Microporidæ. Looking at the same preparation from below, the zoœcial chambers are seen separated by a considerable free space, and to about the median line of the zoœcial chamber there is a row of single † muscles, or sometimes a small bundle, passing from the lower surface of the zoœcial chamber to the lower surface of the zoarium (Pl. 30. figs. 2 & 3). No structure at all comparable to this has been mentioned as occurring in the Bryozoa; however, the basal calcareous wall gives an indication of their occurrence, by a groove along the line of the muscles, with a pore at the end (Pl. 30. fig. 4); and there is no doubt that fossil *C. umbellata*, Defr., and some other species, had the same muscular arrangement. Further examination of spirit specimens may reveal points which could not be distinguished in the very limited material available.

Whether a new genus should be made before more material and species have been examined is perhaps an open point, though it does not seem that species having such different structures as *C. canariensis* and *C. Lowei* can remain together. If found advisable, *C. Lowei*, *C. umbellata*, etc., might be

* I shall throughout the paper, so far as possible, consider the colony as seen in the position in which it first grows on its support, so that the opercular wall is the upper surface, while the lower or base rests upon the support in the first stage. In doing this no opinion is pronounced on the suggestion that some mature forms may live in a reversed position, and for the same reason the base of the cone is always shown below, even though possibly it might be more correct to reverse it in the mature forms of some species.

† In a very good specimen the threads to the dorsal surface are fine lines, about the same size as the frontal opesial muscles, but in a specimen in which some changes have taken place they are large and alternately light and dark, that is striated, which may be a histological change. At each end the muscle widens out (as in Pl. 30. fig. 28).

placed in a new genus. It is the *Discoporella* of d'Orbigny with *C. umbellata* as the type, but the name having long been used, in mistake, for a Cyclostomatous genus it is better dropped.

These two structures having been briefly referred to, the Selenariadæ can be considered, and an attempt made to understand the relationship and limitations of the group. In all the growth is from the apex, and in *Cupularia*, *Selenaria*, and *Lunulites* it is known that under the apex there is often a grain of sand, a flake of shell or stone, or very frequently the shell of a foram. This was, so far as I know, first pointed out by Defrance, but has since then been frequently and almost amusingly rediscovered, being alluded to by Michelin, Goldfuss, Reuss, Stoliczka, Busk, Beissel, Gabb & Horn, Waters, Maplestone, Robertson, Canu, and Harmer, though frequently it has been thought to be a characteristic of some one species or genus (see Pl. **29.** figs. 1, 7, 8, 9, 10, and Pl. **30.** figs. 10, 12).

The calcareous shell of the Selenaridan colony usually entirely encloses the hard base on which the growth started, showing no sign of the support either above or below, though sometimes the growth is on a much larger stone, as in some specimens of *Cupularia canariensis* from Petit Tahou, Liberia (Pl. **30.** fig. 12). It would seem impossible for a colony so heavily weighted to float, nor can we think it could float in a reversed position. In *Vibracella trapezoidea*, Reuss, there is in several specimens a small projection on the under surface below the apex, caused by the presence of a very young foram, but a few are found growing on much larger specimens of this *Orbitoides stellata*, Gümb., or, as I am told it ought now to be called, *Orthophragma* (see Pl. **29.** fig. 10). This *Vibracella* grows on the foram, and then grows beyond it, like an inverted cup, though in the specimen figured perhaps simultaneous growth of both organisms had taken place. When I first described * *Vibracella trapezoidea*, Reuss, only small flat pieces were available, but since then a number of disk-like forms, from Bocca di Sciesa, Colle Berici, N. Italy, have been cleaned up, closely resembling in size and shape *Cupularia canariensis*. From the same locality I have a few specimens of *Mamillopora bidentata*, Rss., also with the *Orbitoides* attached to the lower surface, but not centrally, nor have the majority anything attached, so that the few cases are probably accidental. No sand or other support has been mentioned as occurring in *Mamillopora*, *Batopora*, or *Conescharellina*.

Returning to *Cupularia* and *Selenaria*, the larva settles on the support mentioned, and round the primary zoœcia there are in *Cupularia*, and usually in *Selenaria*, eight zoœcia which are much smaller and shallower than the peripheral zoœcia, and often in these smaller zoœcia there is no sign of there ever having been an opercular opening. In *Lunulites* there are

* "North Italian Bryozoa," Quart. Journ. Geol. Soc. vol. xlvii. p. 11, pl. 1. fig. 23 (1891).

six or eight zoœcia surrounding the primary. The growth in the surrounding zoœcia in *Cupularia* is shown in my Pl. 30. fig. 11, and Busk has figured them in *C. Johnsoni* *, Busk; *Selenaria maculata* seems to have six zoœcia round the primary †.

Canu mentions eight zoœcia round the primary in *Lunulites lævigata*, Canu; but some *Lunulites* as *L. sella*, Marsson and *L. Goldfussi*, Hag., have only six. I have figured *Selenaria concinna*, Busk (Pl. 30. fig. 9), showing only five zoœcia, but as there are three vibracular chambers these may be taken as representing three zoœcia. There are various Bryozoa in which the primary is surrounded by eight zoœcia, as *Flustrella hispida*, Fab., from Oban, and as shown by Barrois there are eight zoœcia round the primary in ‡ *Microporella impressa*, Aud., and six in § *Membranipora pilosa*, L. In *M. lineata*, L., there are also six, as is the case in *M. nitida*, Johnst., *M. Dumerilii*, Aud., *M. tenuirostris*, Hincks, *Microporella diadema*, MacG., *M. ciliata*, Pall., from Oban, and *M. Malusii*, Aud. These may be taken as typical figures, even if there is some variation. In *Cupularia*, *Selenaria*, and *Lunulites*, the younger zoœcia, sometimes even to three rows round the primary, have a calcareous perforated front, just as we have seen in the ordinary zoœcia of *Cupularia Lowei*, covered on the front by a membrane, to which bundles of muscles passing through the frontal pores are attached to draw it down, so that the structure of these is Microporidan, while the outer zoœcia have a Membraniporidan operculum.

In some Selenariadæ the opercular opening is more or less closed by a tongue-like calcareous projection to which I have referred as occurring in ‖ *Selenaria petaloides* fossil from New Zealand, but in *S. concinna* (Pl. 30. fig. 9) it commences near the proximal end until at last the aperture may be entirely closed. It seems that this closure must be compared with those which I ¶ have described over the operculum of *Schizoporella unicornis* and other Schizoporellidæ, though it takes a rather different form. Maplestone ** has already referred to it.

* Quart. Journ. Micr. Soc. vol. vii. pl. 23. fig. 3.

† I have made sections of the small (3–6 mm.) fossil *Cellepora globularis*, Rss. from the Bartonian of S. Urbano di Mte. S. Greve, Vicentine, a species described by Reuss from Val di Lonte, but in his first description other species were included. Enclosed in the colony, but not in the middle, is a grain of sand without any small zoœcia on it, so that there is no reason for considering that it grew upon the sand or for making any comparison with Selenariadæ. There are two small oral avicularia in the peristomial tube, and this shows it is either *Cellepora* or *Lagenipora*, but no ovicells have been seen.

‡ Emb. des Bry. pl. 16. fig. 2 (1877). § *Loc. cit.* pl. 15. fig. 9.

‖ Quart. Journ. Geol. Soc. vol. xxxix. p. 442, pl. 12. fig. 11 (1883).

¶ Journ. Linn. Soc., Zool. vol. xxxiv. p. 15 (1918).

** "Vict. foss. Selenar.," vol. xvi. p. 217, pl. 25. fig. 8 (1904).

Appendages.

The appendages of the group have not received the attention they deserve, and avicularia have frequently been in a wholesale way called vibracula as in *Conescharellina*, which always has avicularia. The vibracula of *Selenaria* are of a type quite different from anything known elsewhere, for they move in a ring external to the vibracular chamber.

In *Lunulites* there are various forms of appendages all of which have been generally spoken of as vibracula, whereas vibracula only occur in a limited number of forms in the family, such as *Vibracella trapezoidea*, Rss., and *Lunulites mitra*, Marsson (probably *Vibracella*). There are "onychocellaires" as figured by Beissel in *L. Goldfussi*,* Hag., also they occur in *L. sella*, Mars., and *L. salebros*, Mars., and probably in *L. Beisseli*, Mars., in which there is an elongate chamber, usually broken down. *L. cupulus*, Busk =*L. gibbosa*, Busk, also closely related to *L. patelliformis*, Maplestone (*non* Marsson), has a long tapering seta divided at the end (Pl. 30. fig. 16), which is different from anything we are acquainted with, and probably must be considered as avicularian.

Lunulites of the *radiata*-type are the most common, and the avicularian chamber has a projection on each side, but being rarely well preserved they have consequently seldom been sufficiently figured. The name *Lunulites* will probably ultimately be confined to this group, which will include such species as *L. Hagenowi*, Bosc (*non* Beissel), *L. transiens*, Gregory, &c.

I † have on several occasions said that the real difference between avicularia and vibracula consisted in the avicularia only having motion in one direction, whereas vibracula have motion in all directions, and we must look at the base of the appendages, or the chamber containing the muscles, &c., to decide which of the two we are dealing with; whereas the length of the appendage has little classificatory value in the Cheilostomata, for short, round, or triangular avicularian mandibles may be replaced by whip-like mandibles, as in *Microporella coronata*, &c.

In *Cupularia canariensis* the central setæ are very short and small, though quite mature, increasing in size to the periphery, where they are very long. Correct appreciation of the differences between the two organs would have led to their being more considered in classification in the present group, as well as in other recent and fossil forms. *Conescharellina* has avicularia, *Cupularia* and *Selenaria* have vibracula, *Lunulites*, as it has been understood,

* "Ueber die Bry. der Aachner Kreidebildung," pl. 2. figs. 22, 24. Nat. Verh. Holland. Maat. Wetenschappen, vol. xxii., Haarlem 1865.

† "Bryozoa," Résultats du Voyage du S.Y. 'Belgica' in 1897–8–9, p. 27 (1904).

has avicularia, vibracula, and onychocellaires. *Mamillopora* probably always has avicularia. In *Cupularia*, the muscles are frequently attached to the vibracula by broad bands (Pl. 30. fig. 29), instead of by narrow tendons as is generally the case in avicularian mandibles.

Ovicells.

No ovicells are known in *Cupularia*, but ovaria and embryos are found in the zoœcia near the periphery (Pl. 30. fig. 25), nor are any known generally in *Selenaria*, though the late C. M. Maplestone, in a letter, wrote that in specimens from Queensland he has seen the ovicells of *S. concinna* resembling those of *Conescharellina philippinensis*. In *Conescharellina philippinensis* there is a raised globular ovicell as described by Whitelegge *, and I have some in my collection, though, out of some hundred specimens, ovicells have only been seen in two or three. The ovicell, like the operculum, is directed to the centre of the zoarium in a puzzling manner. *Conescharellina eocœna*, Neviani, also has ovicells.

In *Mamillopora simplex*, Kosch., the ovicell is a raised inflation and is widely open, as in *Haloporella*. In *Orbitulipora petiolus*, Lonsd., the ovicell is also globose. Smitt† figures it in *Mamillopora cupula*, Sm.; Reuss and I have described it in *Batopora multiradiata*, Rss. "*Cupularia bidentata*," ‡ Rss., also shows an ovicell, but from the figures it was not clear to what genus it belongs, but now it is found to be *Mamillopora*, closely allied to *M. simplex*, Kosch.

Most of the published figures of the earlier authors gave the Selenariadæ upside down, whereas in such genera as *Cupularia*, *Selenaria*, *Lunulites*, the distal end with its Membraniporidan aperture should be shown at the top. Maplestone ‖, when dealing with *Conescharellina*, says, in accounting for the position, "the free edge of the operculum is directed towards the apex, but it is not the distal edge. The fact is that the operculum is hinged at the distal end and not at the proximal one; so that in the conical forms not only are the zoœcia upside down but the operculum is also upside down." Difficult as it is to understand this reversal it seems to be the case in *Conescharellina*, but not in *Cupularia*, *Selenaria*, or *Lunulites*.

Whitelegge §, Haswell ¶, and Maplestone **, call attention to the semi-

* "Australian Poly." p. 342. 1887; see also Maplestone's "Biporæ," p. 6, pl. 1. fig. 2 (1910).

† Floridan Bryozoa, pl. 2. fig. 33; pl. 7. figs. 146, 147 (1873).

‡ Waters, "Batopora," p. 87, pl. 6. figs. 7, 11 (1919).

‖ "Growth and Habits of Biporæ."

§ "Australian Polyzoa," p. 339. 1877.

¶ "Polyzoa from the Queensland Coast," Proc. Linn. Soc. N.S.W. vol. v. p. 42 (1881).

** "Biporæ," p. 5. 1910.

lunar slits * which seem to occur quite generally in *C. philippinensis*, and at any rate in most species of *Conescharellina*. They are found in quite young zoaria, and in older ones they may occur in various positions; sometimes in a circle, that is at equal distance from the apex. I have seen in a colony two such circles with several slits, sometimes the slits occur along the radial line of the zoaria, in others between two radial lines.

Whitelegge's theory, of these slits being rudiments of intercalated new zoœcia, was declared by Levinsen to be practically impossible, and from the position of these slits it does not seem that they can indicate new zoœcia, also the chambers are smaller and simpler than those of the zoœcia, nor are there so many connections as in the zoœcia. Having a considerable number of good dry specimens of *C. philippinensis*, it was hoped that examination, and sections in various stages, would give an explanation of their function, but this was not easy, though the explanation now offered will, I fully expect, be confirmed when living or spirit specimens are examined.

Conescharellina angulopora (Woods) and *C. flabellaris*, Lev., have a projecting growth at the apex (Pl. 29. fig. 16; Pl. 30. fig. 19) giving much the same appearance as the basal end of *Cellaria* and *Tubucellaria*, both of which are directly attached by tubular radicles to the substratum. The slits, if my theory is right, indicate the radicle chamber; and in a large number of Bryozoa radicle chambers may occur with great frequency, even to each zoœcium, though the radicles may be developed in very small numbers. In a previous paper allusion has been made to the radicle chamber in *Catenaria Lafontii* †, Aud., in which a round spot, on the dorsal surface, was shown to each zoœcium by Savigny, Busk, and others, without it being suspected that this was the opening of a dorsal radicle chamber, until I found a specimen with a few radicles,—although I have seen only a few, since they are very rare.

When a radicle is formed in *Conescharellina* probably the disk closing the chamber is absorbed, and then a semicircular opening occurs as in Pl. 29. fig. 19. *s.s.* Levinsen, p. 310, says "these superficial chambers seen in the whole colony seem to be in mutual connection with each other." They are in communication through rosette-plates.

Some rather important suggestions ‡ have been made that the mature

* Levinsen proposes to speak of lunœcia instead of semilunar slit, but when we have a good name, why do we want to change it, even before the function of the structure is understood? We must resist the tendency to change the name of each minute structure we find. Canu and Bassler say that the lunœcia are openings of "special compensation zoœciules": no proof is given, and I doubt whether it will be found to be the case. See Early Tert. Cheil. Bry. p. 76. 1917.

† "Bry. from Rapallo, &c.," Journ. Linn. Soc., Zool. vol. xxvi. p. 15 (1896).

‡ Maplestone, "Biporæ," p. 3. D'Orbigny, Pal. Franç. p. 447, suggested that the young colonies of *Conescharellina* were perhaps fixed by the conical extremity, and in many cases, at any rate, this seems the most probable.

zoarium floats with the apex at the bottom, and we are awaiting proofs as to how this takes place, as it is difficult to understand. Whitelegge *, in a postscript, says that he has had *C. philippinensis* under examination, and that "nearly every specimen possesses a pair of tubular filaments inserted on each side of the zoarium"; also he thinks "the tube appears to grow out of an avicularium." Will it not be found that they grow from the semilunar slit?

Harmer †, speaking of the Selenariadæ, says that he has some evidence that they may be attached to the ooze by means of very delicate flexible rooting processes, but he does not indicate the species or genus to which he is referring. From fossils and dried specimens of *Conescharellina* the conclusion come to independently, is that there have been radicle processes, but in *Cupularia*, *Selenaria*, and *Lunulites* there is no indication of anything similar.

Classification.

We may now turn to he classification, as these investigations were made to find a natural one, and certainly we are brought up against a most difficult problem. Generally in *Cupularia*, *Selenaria*, and *Lunulites* there is a thick under surface, through which long tubes may pass, or there may be a series of chambers; further, the arrangement of the back as well as the front is radial, all of which seems to be quite different from anything known in other genera. In many cases in the Cheilostomata, such differences as whether the zoœcia are uni- or bilateral, or whether they are adnate or erect, are purely zoarial characters, of no or but slight value in classification, but the characters on the under surface, now dealt with, are not zoarial in the same sense, but are in connection with the zoœcia.

Looking at *Cupularia* and *Selenaria* with their similar opercula, similar lower surface, in most cases with central small zoœcia, often closed, with vibracula in both genera, there can be no hesitation in placing them in the same family; in *Lunulites*, the lower surface is radial and thick, long pores pass through it as in the last two genera, the opercula are similar, but there is a more solid calcareous frontal wall without perforations, though it clearly belongs to the same family. *Lunulites*, as generally understood, requires separating into several genera, as already indicated.

Conescharellina differs from *Cupularia* and *Selenaria* in many particulars, such as the shape of the separable operculum, the reversal of the position of the operculum, the semilunar slit, absence of radial under surface, although the zoœcia are placed radially; on the other hand, in the lower part there are a number of vertical chambers, which seem comparable with the horizontal ones of *Cupularia canariensis*, and it would be strange that species not

* "Australian Polyzoa," p. 347. 1887.

† Presidential Address, Brit. Assoc. Zool. Section, p. (9). 1908.

closely allied should develop into a conical form with small central zoœcia, and should have a series of chambers below the zoœcia. Put shortly, are there a number of Bryozoa from different families with quite different zoœcial characters which have taken on the same way of growth and sub-basal characters, or have related forms with similar growth gradually assumed more divergent characters?

Batopora has small chambers at the lower part, which Reuss and Stoliczka call abortive cells, and these may be homologous with the chambers of *Cupularia canariensis* and *Conescharellina*.

Gregory * would place *Batopora* under *Conescharellina*, but *Batopora* has an oral aperture with a more or less straight lower edge, and a large widely open ovicell—in fact, in most characters it resembles *Holoporella*, showing no reversal of the position of the zoœcia, also the zoaria are more globular than conical. I am not sure that I understand what Gregory meant about the aperture of *Conescharellina clithridiata*, Greg., which seems to be *Holoporella* or *Cellepora*.

Trochopora, d'Orb. has the whole of the base filled in by a calcareous growth through which pass very long pore tubes (Pl. 30. fig. 17). This character may not be universal and is discussed on page 418. The base has radial divisions just like those of *Lunulites*, *Cupularia*, &c., and in making sections these radial divisions are seen at every stage of the preparation (Pl. 29. fig. 18). A specimen of *Selenaria nitida*†, Maplestone, in the British Museum, from 22 miles E. of Port Jackson, has the cone entirely filled in with a solid calcareous mass, and in some cases shows radiating lines at the base just as in *Trochopora*. Canu & Bassler ‡ place *Trochopora* and *Otionella*, Can. & Bassl. under Membraporina §, which belongs to Malacostega, but *Lunularia* they place with Opesi lidæ, that is Coilostega. If there were sufficient reason for this it would indicate that the new classification has some weak points, but I fail to find sufficient grounds for separating *Trochopora* from *Lunulites*.

My conclusions are, that of the forms with discoid or cupuliform growth there are two main divisions with one subgroup.

(1) Those with the operculum in the frontal membrane, a radial base, and usually no ovicell, including *Cupularia*, *Selenaria*, *Lunulites*, with *Selenariopsis*, Maplestone, *Trochopora*, d'Orb., *Otionella*, Can. & Bassl., *Heteractis*, Can. & Bassl.

(2) Those with usually a fairly large operculum fitting into the Lepralioid or Holoporellidan oral aperture; with a large ovicell widely open in front, as

* "Brit. Paleog. Bry.," Trans. Zool. Soc. London, vol. xiii. pt. 6, p. 251 (1893).

† "Results of Deep Sea Investigations," Records of the Australian Museum, vol. vii. p. 271, pl. 77. fig. 8 (1909).

‡ "Tert. Cheil. Bry.," U.S. Nat. Mus. Bull. 96, p. 10 (1917).

§ Levinsen, "Morph. Cheil. Bry." p. 144. 1909.

in *Mamillopora* *, *Sphæropora*, Haswell †, *Kionidella*, Kosch., as well as *Batopora* and *Stichoporina* ‡, Stol. (*non* Kosch.) with smaller oral apertures. At the base the zoaria may be radial, or there may be a growth of zoœcia over the radiate zoœcia §.

(3) As a subgroup, those with a small, nearly oval oral aperture, with a separable operculum, having muscular dots fairly near together. The zoœcia are directed to the apex, there are semilunar slits and a small raised globular ovicell, the avicularia are adventitious, whereas in *Cupularia* they are vicarious. Only *Conescharellina* is known in this subgroup.

The first division, if only the zoœcial characters were considered, would come under the Membraniporidæ of Levinsen ‖, which is a very large family, or rather a casual ward for the homeless.

Canu ¶ places *Lunulites* under Onychocellidæ, but only a part have "onychocellaires," while some have vibracula, and others have avicularia, as proved by the symmetrical avicularian chambers; *Cupularia* he places under the Opesiulidæ, in which family he puts *Micropora*, as he recognized in the fossils, what most others had not appreciated, that the frontal pores, where they exist, are opesiules. The muscles passing through these pores have now been seen in my stained preparations.

Besides the genera mentioned, the question of the relationship of the following must be considered :—

1846. *Stichopora*, Hagenow.

1847. *Prattia*, d'Archiac, Mém. Soc. Géol. de la France, vol. iii. p. 407.

1851. *Discoporella*, d'Orb., is *Cupularia*.

1851. *Discoflustrella*, d'Orb., is *Cupularia*.

1851. *Discoflustrellaria*, d'Orb., Marsson says only worn *Lunulites*.

1851. *Cymbalopora*, Hag. This is much like *Conescharellina*. The underside has been mistaken for the upper side.

1863. *Discoescharites*, Roemer, Nord. deutsch. Tert. Poly. p. 21, is *Lunulites*.

1864. *Bicupularia*, Reuss, Sitzb. Akad. math.-naturwiss. vol. l. p. 9, pl. 3. fig. 2 (1864).

1882. *Ascosia*, Jullien, must be placed under *Mamillopora*.

1887. *Bipora*, Whitelegge, is *Conescharellina*.

* See Neviani, "Nuova specie fossile di Stichoporina," Riv. Ital. di Paleont. pp. 1–4. 1895.

† Proc. Linn. Soc. N.S. Wales, vol. v. p. 42, pl. 3. figs. 5, 6 (1880).

‡ Stoliczka, "Olig. Bry. von Latdorf," Sitz. Akad. der Wissensch. Wien, vol. xlv. p 92.

§ This group is dealt with more fully in Wäters, "*Batopora* and its Allies,' Ann. Mag. Nat. Hist. ser. 9, vol. iii. 1919.

‖ "Morph. Cheil. Bry." p. 143.

¶ "Bry. foss. de l'Argentine," Anal. del Museo Nacional de Buenos Aires, vol. xvii. p. 275 (1908).

1893. *Biselenaria*, Gregory, nom. nov. = *Diloptaxis*,* Reuss (a name previously employed elsewhere). From Reuss's figure this looks like *Cupularia* with the frontal growth continued on the under side of the zoarium, meeting in the middle. *Sphæropora fossa*, Haswell, in the same way, grows from the upper side over to the under side (see "Batopora," p. 80).

1897. *Ennalipora*, Gabb & Horn. It is put by Yves Delage (with a ?) in the Selenarina, but this is clearly a slip.

1913. *Selenariopsis*, Maplestone.

Species of these groups have been dealt with in a large number of works, but special reference is made to structure or relationship in the following :—

Busk, Brit. Mus. Catal. pt. 2, p. 97. 1854. † (B.M. Cat.)

Busk, Fossil Polyzoa of the Crag, p. 78. 1859. † (Crag.)

Stoliczka, "Oligoc. Bry. von Latdorf," Sitz. Ak. der Wissensch. Wien, vol. xlv. p. 71. 1862.

Tenison Woods, "On some Recent and Fossil Species of Australian Selenariadæ," Trans. Phil. Soc. Adelaide, vol. iii. p. 1. 1880. † (Selenariadæ.)

Waters, "Bryozoa from N. S. Wales," Ann. Mag. Nat. Hist. ser. 5, vol. xx. pp. 199–202. 1887. † (N. S. Wales.)

Whitelegge, "Notes on some Australian Polyzoa," Proc. Linn. Soc. N. S. Wales, vol. ii. pp. 337–347. 1887. † (Austr. Poly.)

Maplestone, "Notes on the Victorian fossil Selenariidæ," Proc. Roy. Soc. Vict. N.S. vol. xvi. p. 207. 1904. † (Vict. Selenar.)

Maplestone, "On the Growth and Habit of Biporæ," Proc. Roy. Soc. Vict. N.S. vol. xxiii. 1910. † (Biporæ.)

Maplestone, "The Exped. of H.M.C.S. 'Miner': Polyzoa," Rec. Austr. Mus. vol. vii. 1909.

Maplestone, Supplement, *op. cit.* vol. viii. 1910.

Waters, "*Batopora* (Bryozoa) and its Allies," Ann. Mag. Nat. Hist. ser. 9, vol. iii. p. 79. 1919. † (*Batopora*.)

The following also are referred to under the contractions † given :—

Canu, "Contributions à l'étude des Bry. foss. des Terrains du Sud-Ouest de la France," Bull. Soc. Géol. de France, various volumes. † (Bry. foss. France.)

Levinsen, Morph. and Syst. Studies on the Cheil. Bryozoa. 1909. † (Morph. Cheil.)

Manzoni, Bri. foss. del Mioc. d'Aust. ed d'Ungheria, Wien. Denks. xxxvii. 1877. † (Mioc. d'Aust.)

Manzoni, "Bri. plioc. Ital.," Sitz. Wissensch. Akad. Wien, lix.–lxxi. 1869–71. † (Bri. plioc. Ital.)

Norman, "Polyzoa of Madeira and neighbouring Islands," Journ. Linn. Soc., Zool. vol. xxx. † (Poly. Madeira.)

Waters, "Bryozoa from N. S. Wales," Ann. Mag. Nat. Hist. ser. 5, vol. xx. † (N. S. Wales.)

* "Ueb. einige Bry. aus dem deutsch. Unterolig.," Sitz. Akad. Wiss. math.-nat. Cl. vol. lv. p. 231, pl. 2. figs. 5–7 (1867).

† Contractions used in the text.

Cupularia.

The name *Cupularia* was first suggested by Lamouroux for the fossil "*Lunulites urceolata*" Lamk., which Lamouroux subsequently figured for the first time, though neither from the description nor figure will it ever be possible to know what species was intended. D'Orbigny, accepting Lamouroux's suggestion, described the genus *Cupularia*, and Busk, apparently forgetting that d'Orbigny had done so, again introduced it. Canu * figures a species as *Lunulites urceolata*, Cuv. and says that this Paris basin species has been known for a century by geologists as *L. urceolata*, and so long as it is not considered as the species of Lamouroux, this seems to cause least difficulty, though Cuvier gave no description, but then we must not call *L. urceolata*, Cuv., as figured by Canu, a synonym of *L. urceolata*, Lamk. and Lamx., which it certainly is not. Lamouroux considered his species to be the unfigured *L. urceolata*, Lamk., and his description is verbally copied from Lamarck, to whom Lamouroux submitted much of his material.

Dr. Alice Robertson describes † *Cupularia* under incrusting Cheilostomata, and says "touching the substratum only on the rim of the colony." It is certainly incrusting in its earliest stages, but there is never an attachment confined to the rim. Nearly all forms of Bryozoa are incrusting in the earliest zoœcia, but beyond this, *Cupularia* is not so in the sense in which it has been used for many Cheilostomata.

Cupularia is represented at present by a few species from temperate and tropical regions, and was abundant in the European tertiaries, with some in the cretaceous formation.

Cupularia canariensis, *Busk*. (Pl. 29. figs. 1–5; Pl. 30. figs. 11, 12, 21, 22, 25.)

Cupularia canariensis, Busk, Q. Journ. Micr. Sc. vol. vii. p. 66, pl. 23. figs. 6–9 (1859); "Crag," p. 87, pl. 13. fig. 2 (1859); de Angelis, "Anthos. y Brios. plioc. de Cataluna," R. Acad. de Cien. y Artes de Barcelona, p. 33, pl. B. figs. 6–9 (1900); Waters "N. S. Wales," p. 201 (1887); Waters, Zool. Chall. Exp. Suppl. vol. xxxi. p. 36, pl. 3. fig. 2 (1889); Q. Journ. Geol. Soc. vol. xli. p. 308 (1885); Robertson, "Inc. Cheil. Bry.," Univ. California Pub. Zool. vol. iv. p. 314, pl. 24. figs. 90, 91 (1908); Manzoni, "Bri. Plioc. Ital." pt. i. p. 10, pl. 2. fig. 17 (1869); "Plioc. sup. de Rhodes," Mém. Soc. Géol. de France, ser. 3, vol. i. p. 67 (1887); Seguenza, "Formaz. Terz. Reggio," p. 371 (1879); Pergens, "Plioc. Bry. von Rhodos," Ann. k.k. nat. hist. Hofmus. vol. ii. p. 31 (1887); Neviani, "Cont. alla. Conosc. dei Bri. foss. Italiani," Bull. Soc. Géol. Ital. vol. x. p. 130 (1891); "Bri. foss. della Farnesina," Pal. Ital. vol. i. p. 101 (1895); "Bri. Neoz. di alcuni Loc. d'Italia," Bull. Soc. Rom. per gli Stud. Zool. vol. iv. p. 238 (14), p. 243 (1895); *op. cit.* vol. v. p. 121 (1896);

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* "Bry. des Terrains Tert. des Environs de Paris," Ann. de Paléont. vol. ii. p. 26, pl. 4. figs. 4–8 (1907).

† "Incrust. Cheil. Bry.," Univ. California Pub. Zool. vol. iv. p. 314, pl. 24. figs. 90, 91 (1908).

op. cit. vol. vii. p. 38 (5) (1898); Bri. Neog. della Calabrie, p. 168 (1900); Bri. Terz. ed Postterz. p. 362 (1900); "Bri. foss. di Carrabare," Bull. Soc. Géol. Ital. vol. xxiii. p. 552 (1905); Canu, Bry. foss. de l'Argentine," Ann. del Mus. Nac. de Buenos Aires, vol. xvii. p. 275. pl. 5. figs. 8-10 (1908); "Bry. foss. France," vol. xiii. pp. 124, 128 (1913); *op. cit.* ser. 4. vol. xvi. p. 137, pl. 3. figs. 4, 5, 6 (1917).

Membranipora canariensis, Smitt, Floridan Bry. pt. 2, p. 10, figs. 69–71 (1873).

Cupularia guineensis, Busk, B. M. Cat. pt. 2, p. 98, pl. 114 (1854); Zool. Chall. Exped. vol. x. p. 206, pl. 14. fig. 6 (1884); Norman, "Poly. Madeira," p. 289, pl. 37. figs. 2–6 (1909); Osburn "Bry. of the Tortugas Isl.," Pub. Carnegie Inst. 182, p. 194 (1914).

Lunulites canariensis, Manzoni, "Mioc. d'Aust." p. 72 (24), pl. 17. fig. 56 (1877).

Cupularia canariensis, as shown by stained sections, has at the base a series of parallel chambers (Pl. **29**. figs. 1, 2, 4) filled with granular substance, and with a connection from each chamber to its neighbours, through rosette-plates (see page 400). These chambers must surely be homologous with those of *Conescharellina*, as seen in *C. philippinensis, angulopora*, etc., even though the shape is somewhat different. In whole stained preparations of *C. canariensis* these chambers can be seen at the base forming squares or rectangles (Pl. **29**. fig. 5), yet in many cases the calcareous zoarium shows no sign of these squares, but only the radial lateral ridges meeting in the centre of the lower wall.

Careful examination, however, often shows the cross lines in some places, where only the more distinct radial lines are seen at first, and in some fossil forms the squares can clearly be distinguished, so that this is a character which must be dealt with cautiously.

No ovicells are known in *Cupularia*, but there are ova and large embryos shown in sections, from which it is clear that they emerge directly without passing into any external ovicell. In *C. canariensis* there are 14 tentacles, the same as in *C. Johnsoni*.

I have on several occasions maintained that *C. canariensis* and *C. guineensis* are synonyms, and Norman*, agreeing with me in their identity, wishes to take Busk's earlier name of *guineensis*; but Canu, considering that *canariensis* has been universally used for half a century, and that for both these the author is the same, considers we should retain the name *canariensis*. Canu also thinks that the figure of *canariensis* was good, whereas that of *guineensis* was bad. Having several times compared the British Museum specimens, it does not seem that we must speak of a bad figure, though in the specimens there may be in parts the structure as figured in *canariensis* as well as that of *guineensis*, and I agree with Canu in thinking we should retain the name *canariensis*, which has often been well described. Should other characters be found in *guineensis*, it will be open to re-consider the name.

Loc. Madeira; Canaries, 80–250 met. (*Calvet*); Florida (*Smitt*); Tortugas (*Osburn*); Cape Blanc (*Calvet*); Liberia; Philippine Is.; New Guinea;

* Linn. Soc. Journ., Zool. vol. xxx. p. 289 (1909).

off Cape York, Australia; S. Pedro, 4 fath., and S. Catalina, California (*Rob.*); Oran (Algiers).

Fossil. Miocene: Austria and Hungary (*Manzoni*); Pliocene: Crag, Italy, Spain, Rhodes, Monte Mario, Rome; Pleistocene: California (*Rob.*); Quaternary: Italy; Tertiary: Bahia-Blanca, Argentine (*Canu*); Aldinga, Australia.

Cupularia Lowei, *Busk.* (Pl. **30**. figs. 1–6, 26–29.)

Cupularia Lowei, Busk, B. M. Cat. p. 99, pl. 116. figs. 1–6 (1854); Norman, "Poly. Madeira," p. 290, pl. 37. figs. 7–12 (1909); Osburn, Bry. of the Tortugas Islands, Florida, p. 194 (1914).

Canon Norman kindly gave me a few spirit specimens, from Madeira, and of one I have prepared a most interesting whole stained decalcified preparation.

Looked at with the frontal membrane in focus, a number of small bundles of muscles (Pl. **30**. fig. 1) are seen which pass from the membrane through the frontal pores; then focussing lower down, as if the membrane had been removed, we see what must perhaps be called a semicircular opesium through which the polypide protrudes (fig. 2). The zoœcia are connected by means of tubes in which there are septa or rosette-plates, where the neighbouring tubes join. The zoœcial chambers are seen as quite separate sacs.

Looking at the zoarium from below, the zoœcial chambers are separated by a considerable space, and to about the median line of the zoœcial chamber there is a row of muscles which pass from the lower surface of the zoœcial chamber to the lower surface (fig. 3) of the zoarium.

The muscle threads are usually single, though occasionally two or three occur together, and there are here and there similar muscles to other parts of the zoœcial chamber. This hydrostatic system is different from anything yet recorded, and having in the lower part of the zoarium this muscular system and no basal chamber as in *C. canariensis*, Busk, it seems questionable whether they can remain in the same genus.

The calcareous dorsal surface, especially if rubbed down a little, shows short grooves, with frequently a pore at the end (Pl. **30**. fig. 4). These of course indicate where the row of bundles of muscle occur. The peripheral zoœcia on the dorsal surface have small granulations, but the older parts have elongate slight protuberances.

The dorsal pore and grooves occur very distinctly in *Cupularia denticulata* fossil from Veletri, near Lorenzano, on the hills near Pisa, in my collection, and less distinctly on fossils from San Gemignano, near Siena, as well as from the Antwerp Crag (all collected by me). The same structure evidently

occurs also in *C. Oweni*, Busk of the B.M. Cat., but this may be *umbellata*, and it may also be seen in *C. denticulata* of the Crag.

This species is much like *C. umbellata*, Defr., but the lobed or irregular growth of *C. Lowei*, as described by Busk and Norman, has not been mentioned in *umbellata*, though it occurs in "*Cupularia deformis*" Busk, MSS. in the British Museum, which however is closely allied to *C. denticulata*, with the denticles very wide and solid. The zoaria grow in irregular shapes, often lobed just like *C. Lowei*; and Reuss in his manuscript afterwards published by Manzoni * speaks of the growth of *C. Haidingeri*, Rss., being excentric, and from the figures it has the groove mentioned as occurring in *C. Lowei*. The "*deformis*" occurs from the Porcupine Expedition, 45 fath. (B.M.); Tangier Bay, 35 fath. (B.M.); Ras el Amourh, 45 fath. (B.M.); Cape Sagras (B.M.), Portugal; and in my collection from Mer el Kebir, Oran, 50 metres; I propose to place it under *denticulata*.

The polypide of *C. Lowei* is about double the size of that of *C. canariensis*. The frontal membrane has no trabeculæ comparable with that of *Selenaria maculata*, but there is a minute chitinous curve from the base of the oral aperture to the boundary of the zoœcium (Pl. 30. fig. 1). We thus know *Cupularia* with regular, and others with irregular zoaria of the *Lowei* form, having large frontal pores; also the same zoarial forms with denticulate lamina.

Loc. Madeira (*Busk*), common in 50–70 fath. (*Norman*); Tortugas Islands, 12–22 fath. (*Osburn*); North Carolina (*Verrill & Osburn*); Oran.

CUPULARIA JOHNSONI, *Busk*. (Pl. 29. fig. 17; Pl. 30. figs. 23, 30, 31.)

Cupularia Johnsoni, Busk, Q. Journ. Micr. Sci. vol. vii. p. 67, pl. 23. figs. 1–5 (1859); Norman, "Poly. Madeira," p. 290, pl. 38. figs. 1–6 (1909); Canu, "Bry. foss. France," vol. xvi. p. 139 (1917).

Cupularia Reussiana, Manzoni, "Bri. plioc. Ital." p. (11), pl. 2. fig. 19 (1869); "Bry. plioc. sup. de l'Ile de Rhodes," Mém. Soc. Géol. de la France, ser. 3, vol. i. p. 67 (1877); Waters, "Bry. from the Plioc. of Bruccoli," Trans. Manchester Geol. Soc. vol. xiv. p. 480 (1878); Seguenza, "Formaz. terz." pp. 131, 208 (1879); Neviani, "Bri. Neoz. di alcune loc. in Italia," Bull. Soc. Rom. vol. iv. p. (7), 115 (1895): *op. cit.* vol. iv. p. 243 (19) (1895); "Bri. Neog. della Calabrie," Pal. Ital. vol. vi. p. 169 (1900).

Discoflustrella doma, d'Orb. Pal. Fr. vol. v. p. 561 (1850–2).

Cupularia doma, Smitt, "Floridan Bry." pt. 2, p. 15, pl. 3. figs. 81, 84 (1873).

The Madeira specimens, though in spirit, had evidently been dead some time before preservation, and externally had grains of sand adhering to the membranes, while internally diatoms were numerous, so that satisfactory preparations were impossible.

The large cells lining the zoœcial and other walls are very marked, and the

* "Mioc. d'Aust." p. 71, pl. 16. fig. 54 (1877).

embryos (about 0·5 mm. long) nearly fill the zoœcial chambers. They are about the same size as in *C. canariensis*. The under surface of the Oran specimens are spinous (Pl. 29. fig. 17), but in a fossil from Rhodes the under surface is uneven, rather mamillate than spinous, and a fossil from Monte Mario, near Rome, is almost plain underneath.

This was, no doubt, first met with by d'Orbigny, who called it *Discoflustra doma*, but it was not figured, and the description was insufficient for recognition, though now having specimens from the same locality as d'Orbigny, with the "dessous très rugeux comme epineux," we may feel practically certain as to the identity, though as Busk first gave it a recognisable description it must be called *Johnsoni*.

More than one mistake has been caused through d'Orbigny creating the genus *Discoflustrellaria*, with the species *doma* (probably *Lunulites*), and also *Discoflustrella* with the species *doma*.

Loc. Madeira; Mediterranean; Oran, Algiers (*Waters & Canu*), 152 fath.; Benzert Road, Tangier, and Ras el Amourh, 45 fath. (all Brit. Mus.).

Fossil. Castelarquato, Bruccoli, Rhodes (Pliocene); Ravagnex (*Nev.*), Amato (*Nev.*), Benestare (*Seg.*), Tortonian; Terreti (*Seg.*); Leognan, Gironde, France (Burdigalien) (*Canu*).

CUPULARIA UMBELLATA (*Defrance*).

Lunulites umbellata, Defrance, Dict. des Sc. Nat. vol. xxvii. p. 361 (1823).

Lunulites urceolata, Blainville, Man. d'Actin. ou de Zoophytologie, p. 449, pl. 72. fig. 1 (1834).

Discoporella umbellata, d'Orb. Pal. Fr. p. 473, pl. 717. figs. 1–5 (1850–2).

Discoporella Beradana, d'Orb. *loc. cit.* p. 474.

Lunulites Haidingeri, Reuss, Foss. Polyp. des Wien. Tert. p. 58, pl. 7. figs. 26, 27 (1847).

Cupularia Haidingeri, Manzoni, "Mioc. d'Aust." p. 71 (23), pl. 16. fig. 54 (1877); Canu, "Bry. foss. France," vol. xiii. pp. 124, 125, 128 (1913); p. 320 (1915); *op. cit.* vol. xvi. p. 138 (1917).

Cupularia umbellata, Manzoni, "Bri. Plioc. Ital." pt. 1, p. 26 (10), pl. 2. fig. 16 (1869); "Bri. del Plioc. Ant. di Castrocaro," p. 39, pl. 5. fig. 67 (1875); Smitt, "Floridan Bryozoa," p. 14, pl. 3. figs. 75–80 (at least 79, 80) (1873); ? Hincks, "Poly. and Hyd. of the Mergui Archipelago," Journ. Linn. Soc. vol. xxi. p. 125 (1887); Seguenza, "Terz. Reggio." pp. 131, 296, 371 (1879); Calvet, Expéd. Sc. du 'Travailleur' et du 'Talisman,' vol. viii. p. 393 (1907); Canu, "Bry. foss. de l'Argentine," Ann. del Mus. Nac. de Buenos Aires, vol. xvii. (ser. 3, vol. x.) p. 275, pl. 5. figs. 4, 5 (1908); "Bry. foss. France," ser. 4, vol. ix. p. 448 (1909); vol. xiii. p. 130 (1913); vol. xiv. p. 322; vol. xv. p. 332 (1916); vol. xvi. p. 137 (1917); Neviani, Boll. Soc. Rom. per gli Studi Zool. vol. iv. p. 243 (1895); *"Bri. foss. della Farnesina" (pars), Pal. Ital. vol. i. p. 101 (1895); Canu, "Bri. Helv. de l'Égypte," Mém. Inst. Égyptien, vol. vi. p. 205 (1912).

When the frontal calcareous wall is partly broken down there is resemblance to *C. denticulata*, which has sometimes caused confusion between

* I am unable to accept all his synonyms.

the two, but specimens of fossil *umbellata* from the Pliocene of S. Gemignana, near Siena (one of which is flat and must have been at any rate 25 mm. in diameter, while another is more raised and is 8 mm. diameter), show that the proximal part of the oral aperture is a calcareous bar or wall, often directed upwards, while near each end there is a small ridge or tooth, and the frontal wall has a row of large pores near the border, with smaller ones in the central portion. A part of the zoarium, not quite at the centre of the large piece, has a thick wall over the front with few small pores and sometimes with no opercular aperture. This structure is the same as that of the central zoœcia.

Specimens I collected from the Antwerp Crag, and consider to be *denticulata*, have no calcareous wall up to the proximal end of the oral aperture, except in a few cases near the centre of the zoarium, where there are 4–5 very large pores and not a row round the border. The denticles are large and stout, whereas in the broken down *umbellata* mentioned they are much more numerous and smaller.

*C. umbellata**, as described, differs from *C. Lowei* in having regular zoaria instead of irregular and lobed-shaped ones, as well as in some zoœcial characters. A new genus must probably be created for *C. Lowei*, *C. umbellata*, etc.

Loc. Florida (*Smitt*) ; Canaries (*Canu*) ; Cape Verde Islands, 1900 met. (*Calvet*) ; Mergui Archipelago (*Hincks*).

Fossil. Oligocene and Miocene : France ; Miocene : Austria and Hungary ; Pliocene : Crescentino, Bordighera, Siena (*A. W.*) ; Rhodes.* Burdigalian, Helvetian, Tortonian, Plaisancian, Astian, Sicilian, and Quaternary of Italy. Bahia-Blanca, Argentine (*Canu*).

SELENARIA CONCINNA, *Tenison Woods.* (Pl. 30. figs. 7–10.)

Selenaria concinna, T. Woods, Trans. Phil. Soc. of Adelaide, vol. iii. p. 10, pl. 2. figs. 11 *a*–11 *c* (1880); Waters, "N. S. Wales," p. 201, pl. 5. fig. 11 (1887) ; MacGillivray, "Tert. Vict." p. 48, pl. 7. fig. 15 (1895).

At the distal end of the vibraculum there is an incomplete ring attached by a kind of stalk at one side of the vibraculum. This is seen in fig. 8, with the zoarium somewhat tilted so as to look into the opening. The base of the seta works upon this incomplete ring and the muscles pass through the ring. I † spoke of this ring in *S. concinna*, Busk as a tubular projection and also figured it.

* Pergens in his "Bry. von Rhodos," p. 30, gives the synonyms of *umbellata*, and on the next page after "non" gives a list of species not to be placed under *umbellata*. Miss Jelly unfortunately seems to have overlooked the "non," and in her Catalogue makes Pergens responsible for placing five of these species under *umbellata*.

† "N. S. Wales," p. 201, pl. 5. fig. 11 (1887).

The primary zoœcium is surrounded by five secondary zoœcia, and there are three vibracula, so that we get eight chambers, which is the number of surrounding zoœcia in so many of the group, that it seems almost general. The earlier vibracula are much smaller than the later ones, which are also relatively much wider.

MacGillivray expresses some doubt as to whether the specimens which I described were the species of T. Woods, who described the avicularian chamber as having the edges studded with very fine teeth. I concluded that Woods' specimens had the front broken down, when instead of the pores described by me we have irregular teeth. It does not seem that there can be any doubt as to the recent and fossil forms being the same species.

The opesia are much larger than the operculum, except in the central zoœcia, where the operculum is the same size as the calcareous opening. In *Lunulites* the opening is similarly opesial.

Loc. Off Port Stephens, New South Wales, 25 fath.

Fossil. Muddy Creek, Gellibrand, and Lake Bullenmerri, Victoria (*MacG.*).

SELENARIA PUNCTATA, *Tenison Woods.* (Pl. 29. fig. 7.)

Selenaria punctata, T. Woods, Trans. Phil. Soc. Adelaide, vol. iii. p. 9, pl. 2. fig. 8 (1880 Waters, "N. S. Wales," p. 201 (1887); Maplestone, Proc. Roy. Soc. Victoria, N.S. vol. xvi. p. 208, and described again on p. 212, pl. 24. fig. 2 (1904).

S. fenestrata, Haswell, Proc. Linn. Soc. N.S.W. vol. v. p. 42 (1880).

My recent specimens from Port Stephens and from Princess Charlotte Bay, N.E. Australia, are a trifle larger than the measurements given by Maplestone, the zoœcia being 0·23 mm. wide and long. I * called a fossil from Muddy Creek *punctata*, though mentioning the size of the aperture as 0·21 mm., whereas in the recent form it is only about 0·09–0·14 mm. Later MacGillivray † placed the fossil as *T. punctata* and called attention to the large size of the zoœcia.

Maplestone ‡ would call the fossil *S. magnipunctata*, though it is an open question as to whether the mere difference in size between a tertiary fossil and recent forms is sufficient to necessitate a new species. However, in 1887 I was describing recent forms which are *S. punctata*, and therefore Maplestone has made a slip in placing these under the synonyms of *magnipunctata*. The *S. fenestrata*, Hasw., presented by the Australian Museum to the British Museum, is the *magnipunctata* of Maplestone.

Loc. Off Cape Three Points (*Woods*); Holborn Island (*Haswell*); Princess Charlotte Bay, Port Stephens, N.S.W.; Port Jackson.

* Quart. Journ. Geol. Soc. vol. xxxix. p. 440 (1883).

† "Tert. Poly. Victoria," p. 47, pl. 7. figs. 8, 9 (1895).

‡ "Vict. foss. Selenar." p. 212, pl. 24. fig. 2 (1909).

SELENARIA MACULATA, *Busk*. (Pl. 29. fig. 8 ; Pl. 30. figs. 13–15.)

For synonyms see Miss Jelly's Catalogue and add : MacGillivray, Tert. Poly. Victoria," p. 47, pl. 7. figs. 5, 6, 7 (1895).

As mentioned in my Supp. Rep. Zool. Chall. p. 38, there are spreading round the oral aperture, and ending somewhat lower than the operculum, trabeculæ in the frontal membrane, reminding us of the trabeculæ described by Busk in *Cellaria*, and which also occur in *Onychocella angulosa*, Rss. Busk says that the trabeculæ "appear to lie beneath the common epitheca and not to form mere thickenings of it." Where I have examined them they seem to form part of the membrane. In *Onychocella angulosa* the ends are raised and thicker, and seem to be for the attachment of the muscles to the membrane. The different shapes of the trabeculæ seem to give useful characters wherever they occur. The vibracular setæ are spinous on the one side (fig. 13).

Loc. Holborn Island, Queensland ; Barnard Island, N.E. Australia, 10 fath.

Fossil. Muddy Creek, Bird Rock, Schnapper Point, Belmont, and Cape Bullenmerri (Victoria) ; River Murray Cliffs, S. Australia.

LUNULITES CUPULUS, *Busk*. (Pl. 30. fig. 16.)

Lunulites cupulus, Busk, Voyage of the 'Rattlesnake,' p. 1, pl. 1. figs. 13, 14 (1852) ; B.M. Cat. p. 100, pl. 112. figs. 1–6 (1854).

Lunulites gibbosa, Busk, B.M. Cat. p. 100, pl. 111. figs. 1–6 (1854).

Judging from the chamber the appendage is apparently avicularian, that is to say it has movement in one direction only, but without seeing spirit specimens it is best not to speak too definitely. The mandible or seta is long and large, gradually diminishing to the apex (fig. 16), and near the apex a small branch grows from the side. The figure is taken from a preparation in the British Museum, made by Busk, and only labelled "hairs of *Lunulites*," but comparison with the type-specimen shows that it is certainly from *L. cupulus*, B.

This is clearly allied to *Lunulites repandus* *, Maplestone, and *L. patelliformis*†, Mapl. (non Marsson), but without examining specimens it is not advisable to say more. The fossil *L. patelliformis*, Marsson ‡ (non Mapl.) and *L. semilunaris*, Marss.§, seem also to belong to this group.

Busk changed the name *Lunulites* to *Lunularia*, a change which has not

* "Victorian Selenariidæ," vol. xvi. N.S. p. 216, pl. 25. fig. 7 (1904).

† "Vict. foss. Selenar." p. 215, pl. 25. fig. 6.

‡ "Bry. Weiss. Schreibkreide des Insel Rügen," Pal. Abh. vol. iv. p. 79, pl. 7. fig. 11 (1887).

§ *Loc. cit.* p. 78, pl. 7. fig. 10.

seemed to me necessary, though it might have been better in the first instance. However, the modification did not make a new genus, so that under no circumstances could *Lunulites cupulus*, as proposed by Canu and Bassler, be the type of the genus, for being mentioned in the 'Challenger' Reports in the re-named genus, it does not replace the type, which is, whatever Lamouroux meant for his *L. radiata*, an abundant form under various names.

In all probability *L. cupulus* will have to be placed in a new genus, partly based on the long zoœcia and the stout seta with a simple base.

Trochopora, *d'Orbigny*. (Pl. 29. fig. 18 ; Pl. 30. fig. 17.)

Although I have seen many specimens of *Trochopora*, the state of preservation has not allowed a satisfactory examination of the avicularian (?) chambers, nor are they shown clearly in published figures. The fossils readily break both along the radial and annular lines, and change of the shell has taken place so that the minute structure cannot be studied. Near the tubes passing through the calcareous base, and also near some of the annular lines, the calcareous matter has become chalky, showing in section white against the more transparent parts. In making horizontal sections the radial divisions, as in fig. 18, are seen in every part of the solid interior, that is to say, there is a succession of the same structure.

The interior of the cone is filled in with a solid calcareous mass in species described as *Trochopora*, but I have not been able to see that it should be separated from *Lunulites*, and finding that *L. conica*, as described and determined by Busk, from the Crag, is sometimes solid and sometimes hollow, as stated by Busk, has confirmed my opinion. Specimens 6722, 6723, 6724, British Museum, are filled in below and are solid, while 6718, from the Red Crag of Sutton, are hollow cones about the same size, with similar annular divisions and similarly worn.

In the British Museum there are also specimens named by various collectors *Lunulites conica*, many large like the Crag specimens ; and in boxes from numerous European localities the solid and hollow forms occur together. There seems ample reason for considering that *Lunulites* and *Trochopora* cannot be separated generically, and further, though very difficult to understand, it does not seem that a specific distinction can be made between those that are solid and those that are hollow. Also we must see whether the large form sometimes called *urceolata* and the small one, as figured by Michelin, are distinct. Further studies with freshly gathered material may help us.

A specimen of *Selenaria nitida*, Maplestone, in the British Museum has the under surface filled in just as in *Trochopora* ; however, the vibracular

chambers are very small and narrow, and at first they were overlooked, but a few are made out clearly. We thus get this structure in two quite distinct groups.

HELIODOMA IMPLICATA, *Calvet.*

Heliodoma implicata, Calvet, Bull. Mus. Hist. Nat. p. 157 (1906); Expéd. Sc. du 'Travailleur' et du 'Talisman,' vol. viii. p. 396, pl. 26. figs. 7, 10 (1907).

In the British Museum there are some specimens, 1253, to which Busk had given the manuscript name *Cupularia minima*. They grow on grains of sand, shell, or portion of stalk, and the single spiral form of growth can be followed, though it is not so marked as figured by Calvet, and does not end abruptly. The interesting point is that the auricular process is always on the same side; now in the Cupularidæ generally there is a co-relation between the position of the polypide and of the vibraculum, so that a row having the polypide turned to the right (as shown by the cæcum being to the right) will have the auricular process also on the right. In other Cupularidæ there may be one, two or more rows with all turned to one side; when a change takes place, the position of both the polypide and the vibraculum alters together.

Although in the small specimens only a single spiral is visible I should hesitate to make a specific separation, though further material may make this necessary. The spiral growth is most interesting and perhaps nothing quite similar is known in other Bryozoa.

Loc. Cape Verde Islands, 1900 met.; Canaries, 3700 met. (*Calvet*); Ægean Sea, 130 fath., collected by Spratt.

CONESCHARELLINA CANCELLATA (*Busk*). (Pl. 29. fig. 22.)

Lunulites cancellata, Busk (pars), B.M. Cat. p. 101, pl. 113. fig. 5 (non 6) (1854); Waters, "Bry. from Bairnsdale," Q. Journ. Geol. Soc. vol. xxxviii. p. 512, pl. 22. figs. 10, 11 (1882).

Bipora cancellata, Whiteleggc, "Austr. Poly." p. 340 (1887); MacGillivray, "Tert. Victoria," p. 89, pl. 12. fig. 1 (1895).

Conescharellina cancellata, Waters, "Bry. N. S. Wales," p. 200, pl. 4. fig. 24; pl. 6. figs. 13, 18 (1887).

In the British Museum specimens thus named by Busk belong to three or four species. Specimens from Busk's own collection so named are *C. angustata*, d'Orb., of which species I figure a specimen (Pl. 30. fig. 18) from China, sent to me thus named by Jullien. The specimen, pl. 113. fig. 6 (as *cancellata*) in the British Museum Catalogue, has round avicularia as in *C. philippinensis* without any notch in the outer zoœcia, but the minute pore by the proximal end is just visible. The cone is somewhat higher than in *C. philippinensis* in my collection, though no doubt it is that species, as are also the other two small specimens. The larger specimen on the same slide

has the base about twice the diameter of *C. philippinensis*. It has small round or oval avicularia, but the preservation is not very satisfactory.

The under surface of *C. cancellata* has some chambers with one large pore in the centre of the basal wall, sometimes surrounded by small pores, as in *C. angulopora*, Haswell (Pl. 29. fig. 21) and *C. flabellaris*, Lev., while generally there is the large opening of the chamber and smaller openings round it as in Pl. 29. fig. 22. My specimen is from Port Stephens, New South Wales, and, although the front surface is not very well preserved, I think it is the same as Busk's large specimen, for which the name can be retained. My specimen is 4 mm. at the base.

The mistake made, when the type was described, by Busk led me astray when my New South Wales and other specimens were compared in the British Museum, in consequence the specimens then called *cancellata* by me are seen to be *philippinensis*.

Loc. Philippine Islands (*Busk*); Port Stephens, N. S. Wales (*A. W. W. coll.*).

Fossil. Bairnsdale, Gippsland.

CONESCHARELLINA PHILIPPINENSIS (*Busk*). (Pl. 29. figs. 11, 12, 13; Pl. 30. fig. 24.)

Lunulites philippinensis, Busk, B.M. Cat. pt. ii. p. 101, pl. 113. figs. 1, 2, 3 (1854).

Bipora philippinensis, Whitelegge, "Austr. Polyzoa," vol. ii. p. 341 (1887); MacGillivray, "Tert. Poly. of Vict." p. 89, pl. 12. fig. 2 (1895); Maplestone, "Biporæ," p. 3 (1910); Levinsen, Morph. Cheil. Bry. p. 309, pl. 24. fig. 1 (1909).

Conescharellina cancellata, Waters (pars), "N. S. Wales," p. 200. pl. 4. fig. 24; pl. 6. figs. 13, 18 (1887).

The comparison of Busk's type-specimens led me astray, on a previous occasion, as he had placed more than one species under *L. cancellata*, one of these was *C. philippinensis*, but more preparations and more material of the Selenariadæ has enabled me to feel more certain of my position. Unfortunately of *philippinensis* I have only dry specimens, and of all the Selenariadæ have only seen the three spirit specimens mentioned. I have a considerable number of *philippinensis* ranging from very young specimens, from under 1 mm. in diameter, up to mature forms nearly 3 mm. The zoarium is usually rather watch-glass shape, that is convex above and concave below, but it may be flat below; in either case there are a number of small raised avicularia with a semicircular mandible in the middle of the wall of the avicularian chamber.

The oral aperture is oval with a sinus in the part nearest to the periphery of zoarium, there is a distinct notch in the secondary aperture of the outer zoœcia, and a minute pore by the other end of the oral aperture. Numerous round avicularia occur on the front of the zoarium, similar to those on the

under surface, and typically there is one on each side of the zoœcium, and one below the aperture.

On the under side of the zoarium there are a number of chambers (Pl. 29. fig. 11), the youngest ones being avicularian. These chambers, apparently, must be compared with those of *Cupularia canariensis*, and are found in *Conescharellina philippinensis*, *C. angulopora*, *C. cancellata*, *C. flabellaris*, *C. conica*. Whitelegge speaks (*loc. cit.* p. 431) of the zoœcia taking their origin from the cancellated structure, but it is now clear that the zoœcia grow first, and from them the cancellated structure.

The semilunar slit to which Whitelegge called attention, and which Maplestone has also studied, occurs in this species. These semilunar slits have not a definite position in relation to the zoœcia, being most abundant near the apex of the zoarium, and sometimes several are found in the same circle somewhere near the apex, others in a circle half-way between this and the periphery, thus there is considerable irregularity and variation.

In some Conescharellinæ there seem to have been radicles from near the apex, where there is a considerable calcareous cap with pores (Pl. 29. fig. 16), but this is not the case in *C. philippinensis*, in which there is no such calcareous growth, but on p. 405 it is suggested that radicles grew from the semilunar slits, and I expect with living or spirit specimens we shall see confirmation of deductions made from dried specimens. However, I have found no indications suggesting radicles, except in *Conescharellina*, and perhaps *Batopora*.

In the young *philippinensis* the under surface is flat or slightly concave, whereas in older ones the under surface is concave. The younger zoœcia are very much smaller than the older ones, and the secondary apertures are also smaller. A figure (Pl. 30. fig. 24) of a very young zoarium is added, as it shows the small size of the zoœcia, and also the typical position of the avicularia at each side of the zoœcia, which is not so easily seen in more mature forms, as the avicularia are then more irregularly placed.

The raised and globular ovicell, described by Whitelegge and figured by Maplestone, is directed towards the apex. A specimen with ovicells was given to me by Maplestone, but altogether only very few have been seen.

Loc. Philippine Islands (*Busk*) ; Katow, New Guinea, 7 fath. ; Darnley Island, Torres Straits, 10–30 fath. ; Princess Charlotte Bay, N.E. Australia, 13 fath. ; Port Stephens "from weeds on sandy bottom," dredged by Brazier; Moreton Bay, N.E. Australia (*Whitelegge* in lit.) ; Port Jackson.

Fossil. Curdies Creek, S.W. Australia ; Schnapper Point (*MacG.*).

CONESCHARELLINA FLABELLARIS, *Levinsen.*

Conescharellina flabellaris, Levinsen, "Morph. Cheil. Bry." p. 312 (1909).
Conescharellina elegans, Waters, "N. S. Wales," p. 200, pl. 5. figs. 13–17 (1887).
Bipora (?) *elegans*, Whitelegge, "Austr. Polyzoa," vol. ii. p. 346 (1887).

In my "Notes on some Recent Bryozoa in d'Orbigny's Collection," *

* Ann. Mag. Nat. Hist. ser. 7, vol. xv. p. 3, pl. i. fig. 5 (1905).

I said that the examination of d'Orbigny's specimens showed that his *Flabellopora elegans* is not what I described as *Conescharellina elegans*, and since then Levinsen has suggested the specific name *flabellaris* for the latter, and I have adopted it.

One specimen (fig. 17, *loc. cit.*) which I figured is quite bilaminate, while others (like figs. 15, 16, *l. c.*) are much wider, so that the section of one specimen is very much like that of *angulopora* or of *conica* (Pl. 29. fig. 16). The under surface has chambers with a large round pore in the centre and five or six small pores surrounding it, just as in *C. angulopora*, T. Woods (Pl. 29. fig. 21). The avicularia on the upper surface are small and round, whereas in *C. angulopora* and *C. conica* they are large and triangular.

The semilunar slit occurs in various places, but perhaps most often in the region of the apex and the border. The slit is materially wider than the aperture of the ordinary zoœcia, which, as I have suggested before, seems to indicate that the slit could not be for the formation of a zoœcium or zoœcial aperture. In other species there are typically a pair of avicularia by the slit, but there is no rule in this species.

Loc. Port Stephens, N. S. Wales, 7–8 fath.; Port Jackson (*Whitelegge & Lev.*)

Conescharellina angulopora (*Tenison Woods*). (Pl. 29. figs. 6, 19, 21; Pl. 30. fig. 19.)

Lunulites angulopora, Woods, "Austr. Selenariadæ," vol. iii. p. 7, pl. 1. figs. 3*a*–3*c* (1880); Whitelegge, "Austr. Polyzoa," vol. ii. p. 343 (1887).

Lunulites incisa, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 127, pl. 4. figs. 1–3.

Conescharellina angulopora, Levinsen, "Morph. Cheil." p. 311, pl. 23. figs. 7*a*–7*f* (1909).

? *Conescharellina depressa*, Haswell, "Poly. from Queensland Coast," Proc. Linn. Soc. N. S. Wales," vol. v. p. 41, pl. 3. fig. 4 (1880).

There are two very similar species from Australia, but the present one has the larger zoaria with the base of the cone more spread out; the zoœcia and avicularia are also larger, the peristomes at the sides of the oral aperture are more raised, as is also the avicularian chamber and beak. However, the most important character is furnished by the under surface, as the basal wall of the cancelli has a large central perforation with smaller ones round it (fig. 21), as a rule without avicularia, though I saw one case in which there was an avicularian bar to the larger perforation. These perforated walls of the cancelli are mentioned by Tenison Woods in his *angulopora*, and by Haswell for his *Conescharellina depressa*, and although Haswell's figures do not correspond closely with my specimens, there is the probability of both being the same species. The under surface of *C. flabellaris*, Lev., is quite similar. The semilunar slit is larger than in other species examined, being wider than the zoœcial aperture, which would seem to show that it is not for the formation of a zoœcial aperture; the slit may occur either in the row

of the zoœcia or of the avicularia, and often the disk of the semilunar slit has disappeared leaving only a semicircular opening. There is a pore-tube in the wall, at the proximal end of the oral aperture, and a similar tube occurs in *C. philippinensis*, Busk, *C. flabellaris*, Lev., *C. conica*, Hasw., and has been referred to by Levinsen (*loc. cit.* p. 309), and by Whitelegge (*loc. cit.* p. 339).

The dorsal surface of the smaller allied form (see *C. conica* p. 423) has moderate-sized pores with usually a few small triangular avicularia scattered about, though in some specimens none are found. A specimen from Port Stephens, which I think must be *C. cancellata*, Busk, has fairly large round openings at the base with smaller round openings near the larger ones, sometimes surrounding them, in other cases irregularly placed. The base of *C. philippinensis* has numerous small round avicularia, so that the basal surface of *Conescharellina* gives most useful characters. Woods' figure is very unsatisfactory and might represent either of two or three species; though from it together with the description we seem justified in using his specific name. McGillivray* gives this with a ? as fossil, but it really seems as if both his description and figure have got in the wrong places, at least I cannot understand them.

Loc. Port Stephens, N. S. Wales (*Woods*), and 25 fath. sandy mud bottom (sent by Brazier); Bass's Straits (*Hincks*).

CONESCHARELLINA CONICA, *Haswell* (non *Hantken*). (Pl. 29. figs. 16, 20.)

Conescharellina conica, Haswell, Proc. Linn. Soc. N. S. Wales, vol. v. p. 42, pl. 3 figs. 7, 8 (1880).

Conescharellina incisa, Waters (pars), "N. S. Wales," p. 199, pl. 6. fig. 26 (1887).

In describing *C. angulopora*, Woods (p. 422) I have said that there were two very similar Australian species. This smaller one has, however, the axis of the cone relatively much longer, while the larger one has the base relatively much larger. The zoœcia and avicularia are somewhat smaller as is also the semilunar slit, but the most important difference is in the character of the base, for on the under surface of *conica* there are moderate-sized pores, with usually a few small triangular avicularia scattered about, though in some cases none have been found.

I have a specimen of undoubted *C. conica*, Haswell, from Holborn Island, sent to me by Haswell, and which no doubt was determined by him, though, as it is a long time since it was received, more cannot be stated.

At one time it seemed that the name *conica* could not be retained, as it has been used in several closely allied genera, but as we are getting more definite ideas about the genera, there is not as much force in the objection as there was then.

Loc. Holborn Island (*Haswell*); N.E. coast of Australia, 23 fath. (sent by Brazier).

* "Tert. Victoria," p. 46, pl. 8. fig. 1 (1895).

CONESCHARELLINA EOCŒNA, *Neviani*.

Conescharellina eocœna, Neviani, "Bri. Eoc. del Calcare nummulitico di Mosciano presso Firenze," Bol. Soc. Geol. Ital. vol. xiv. p. 122 (6) fig. 5 (1895); Waters, "Batopora," p. 85, pl. 6. figs. 8, 12 (1919).

Batopora conica, Seguenza, "Form. Terz." p. 42, pl. 4. fig. 10 (1879).

Batopora conica, Hantken (*non* Haswell).

This at first was taken for *Batopora*, but the shape of the cone is the same as in various Conescharellinæ, while sections show its relationship, as the interior of the cone is filled in by chambers longer in the direction of a line from the apex to the base (fig. 8, *loc. cit.*). The zoœcia are in irregular longitudinal lines, and are hexagonal or round, with large pores between the neighbouring zoœcia. The visible aperture, which is probably only the secondary aperture, is round or oval. Near the apex of the zoarium there are only small openings with a larger one at the apex, though this is smaller than the pits of *Sphæropora* and *Batopora*. On other *Conescharellina* I have often seen small openings in the secondary growth over the apex, but have never found a central pit. The base of the zoarium shows large pores much like those of *C. conica*, Haswell (Pl. 29. fig. 20). The ovicell is wide, slightly raised, and only occurs near the base of the zoarium.

This seems to be the only species of *Conescharellina* known from the Italian tertiaries, and in some respects it varies from most Conescharellinæ.

Hantken has frequently mentioned *Batopora conica*, Hantk., but attempts made by various people to find where he has described it have failed, and I have in vain looked through most of his papers. Finding specimens presented by Hantken in the British Museum (B. 3724), is therefore most interesting. It is conical, about 5 mm. high, there is considerable swelling at the apex, and one of these shows a hollow surrounded by very small pores, with larger ones over the rest of the swelling. The zoœcia have a nearly round aperture and smaller openings round them. One specimen is cut longitudinally through the middle, showing the cancellate structure, just as in my figure 8, *loc. cit.* The preparation referred to was no doubt made by Hantken.

Loc. Fossil: Mosciano near Florence (*Nev.*); Spiassi, Monte Baldo, N. Italy; between Grotte and Sarego near Lonigo, N. Italy (*A. W.*); Tongrian: Antonimina, Calabria (*Seg.*); Buda Pesth, Lower Clay, Szaboi beds (*Hantken*); also from Schönthal, Festungsberg, Klein, Schwabenberg, and Üröm (*Hantken*).

EXPLANATION OF THE PLATES.

Plate 29.

Fig. 1. *Cupularia canariensis*, Busk, × 25. Stained transverse section showing the shallow central zoœcia (*c.z.*), which have grown upon some substance removed in decalcification, and the large zoœcia (*l.z.*), as well as the vibracular chamber (*v.*) shown near the periphery of the zoarium. The lower part of the zoarium is formed by a series of parallel chambers filled with granular contents and connected by rosette-plates.

2. Do. do. × 200. Lower part of chambers with contents. A and B are connected by a rosette-plate, whereas B and C are close together but not connected at this level. Transverse wall (*t.w.*). Lateral wall of the series (*l.w.*).

3. Do. do. × 250. Transverse section showing contents of the chamber and the large cells.

4. Do. do. × 25. Transverse calcareous section showing chambers.

5. Do. do. × 25. Decalcified base of the zoarium, with muscles of one vibraculum.

6. *Conescharellina angulopora*, T. Woods, × 25. Calcareous section, showing the chambers at the base of the cone. *a* × 3. From Port Stephens, N. S. Wales.

7. *Selenaria punctata*, T. Woods, × 12. Showing a piece from which the central supporting flake has disappeared. From Port Stephens, N. S. Wales.

8. *Selenaria maculata*, Busk, × 12. Showing a piece of shell on which the colony has commenced to grow. It will be noticed that the early central zoœcia are very small. From Holborn Island.

9. *Selenaria petaloides*, d'Orb., × 6. Starting on shell. Fossil from Wanganui, New Zealand.

10. *Vibracella trapezoidea*, Reuss, × 12. Colony growing on *Orbitoides stellata*, Gümbel. Fossil from Bocca di Sciesa, Colle Berici, N. Italy.

11. *Conescharellina philippinensis*, Busk, × 25. Basal view showing small chambers with avicularia and others either broken down or incomplete. From Port Stephens, N.S.W.

12. Do. do. × 25. Section showing zoœcia and basal cells.

13. Do. do. × 25. Quadrant of upper surface showing some of the semilunar slits.

14. *Cupularia canariensis*, Busk, × 85. Showing connecting tubes to the zoœcia and to the vibracular chambers. From Madeira.

15. *Cupularia Lowei*, Busk, × 250. Chamber of peculiar body of the vibracula showing two small glands (*gl.*).

16. *Conescharellina conica*, Haswell, × 25. Calcareous section showing subsequent calcareous growth over the apex. From N.E. coast of Australia.

17. *Cupularia Johnsoni*, Busk, × 25. Under side of the cone showing spinous processes. From Madeira.

18. *Trochopora conica*, Def., ×12. Lower surface. From Salles (Gironde); Helvetian.

19. *Conescharellina angulopora*, T. Woods, × 25. Upper surface. There are two semilunar slits without the plate (*s.s.*). From off Port Stephens.

20. *Conescharellina conica*, Haswell, × 25. Lower surface. From N.E. coast of Australia.

Fig. 21. *Conescharellina angulopora*, T. Woods, × 25. Lower surface. From Port Stephens, N. S. Wales.

22. *Conescharellina* prob. *cancellata*, Busk, × 25. Lower surface. From off Port Stephens.

Plate 30.

Fig. 1. *Cupularia Lowei*, Busk, × 50. Decalcified preparation, looked at from the front. Through the membrane the bundles of muscles attached to it can be seen and they pass through the frontal pores.

2. Do. do. × 50. The same preparation focussed at a lower level. The circular opening is shown through which the polypide passes and the tubular connections from this opening to the neighbouring zoœcia. The polypide is faintly shown in the right-hand zoœcium.

3. Do. do. × 50. The same preparation seen from the dorsal surface. A line of muscles (*m.*) reaching down to the zoœcial chamber is seen, and the polypides are usually alternately right and left in each radial row of zoœcia.

4. Do. do. × 25. Dorsal surface showing pore at the end of the groove.

5. Do. do. × 85. Somewhat pressed down, so that the row of muscles are seen laterally.

6. Do. do. Lateral section; diagrammatic, showing rows of muscles attached to the lower membrane (*l.m.*) and to the zoœcial chamber (*z.c.*).

7. *Selenaria concinna*, T. Woods, × 25. From Port Stephens.

8. Do. do. × 50. Vibraculum.

9. *Selenaria concinna*, Busk, × 25. Showing central zoœcia and a few of the border zoœcia. From off Port Stephens.

10. Do. do. × 25. Section showing double expansion of a pore-tube under the supporting flake.

11. *Cupularia canariensis*, Busk, × 25. Central zoœcia with eight surrounding zoœcia. From Petit Tahou, Liberia.

12. Do. do. × 15. Under surface of same with large sand grain.

13. *Selenaria maculata*, Busk, × 325. Portion of vibracular seta showing spinous fringe on one side.

14. Do. do. × 150. Operculum from inside showing trabeculæ, and below the operculum two muscles attached to the frontal membrane.

15. Do. do. × 85. Size for comparison with previous figures.

16. *Lunulites capulus*, Busk, × 85. Vibracular seta.

17. *Trochopora conica*, Def., × 25. From Salles: Fossil.

18. *Conescharellina angustata*, d'Orb., × 25. From China (*A. W. coll.*).

19. *Conescharellina angulopora*, T. Woods, × 6. Showing growth over the apex.

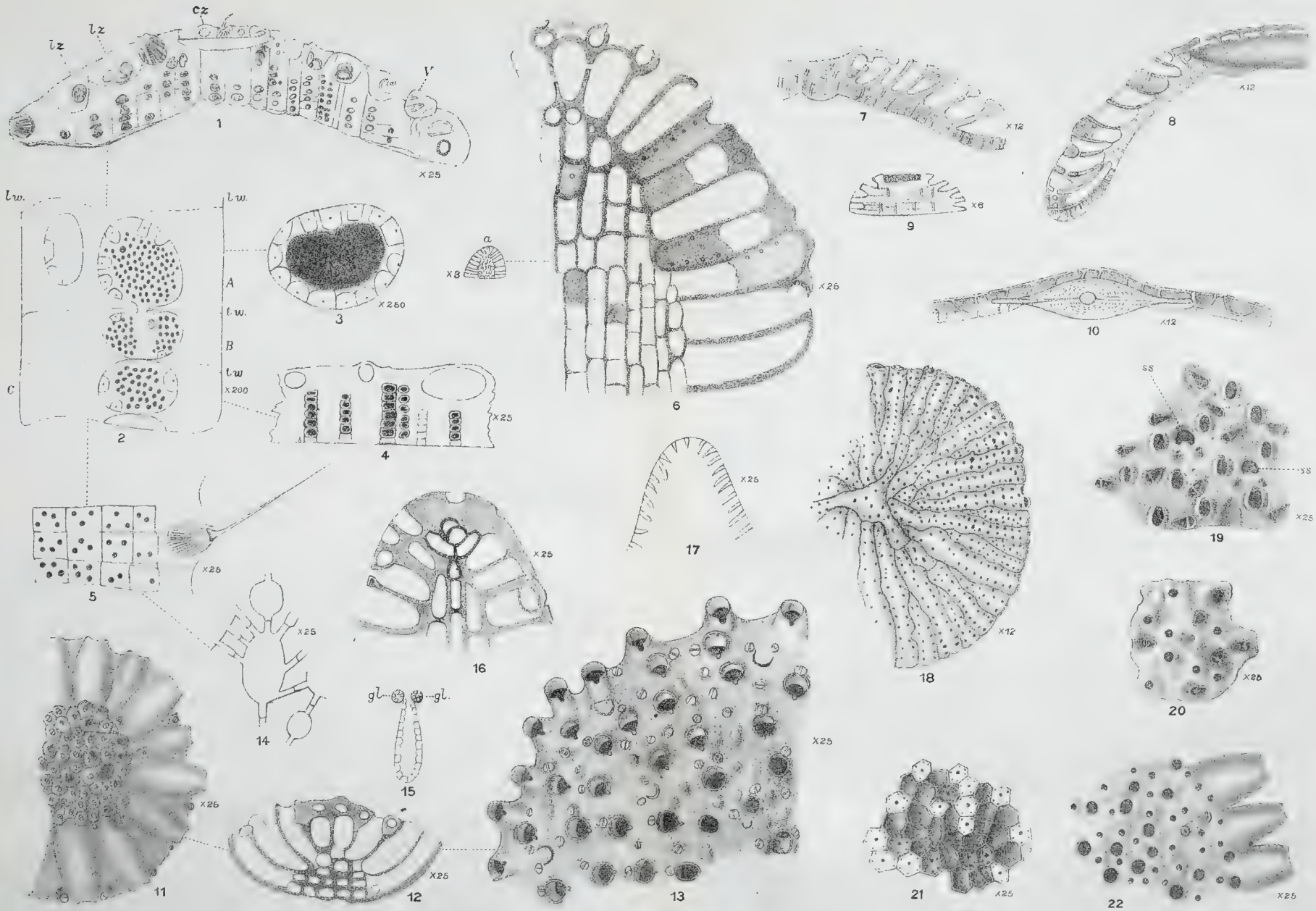
20. *Conescharellina philippinensis*, Busk, × 85. Decalcified to show the position of the zoœcial (*zc.*) and avicularian (*avc.*) chambers.

21. *Cupularia canariensis*, Busk, × 150. Base of seta and front wall of the vibracular chamber.

22. Do. do. × 150. Operculum seen from inside together with the frontal membrane showing trabeculæ.

23. *Cupularia Johnsoni*, Busk, × 150. Operculum from inside with the bordering ridge or trabeculæ united to the zoœcial border.

24. *Conescharellina philippinensis*, Busk, × 25. Young colony.



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BRYOZOA.

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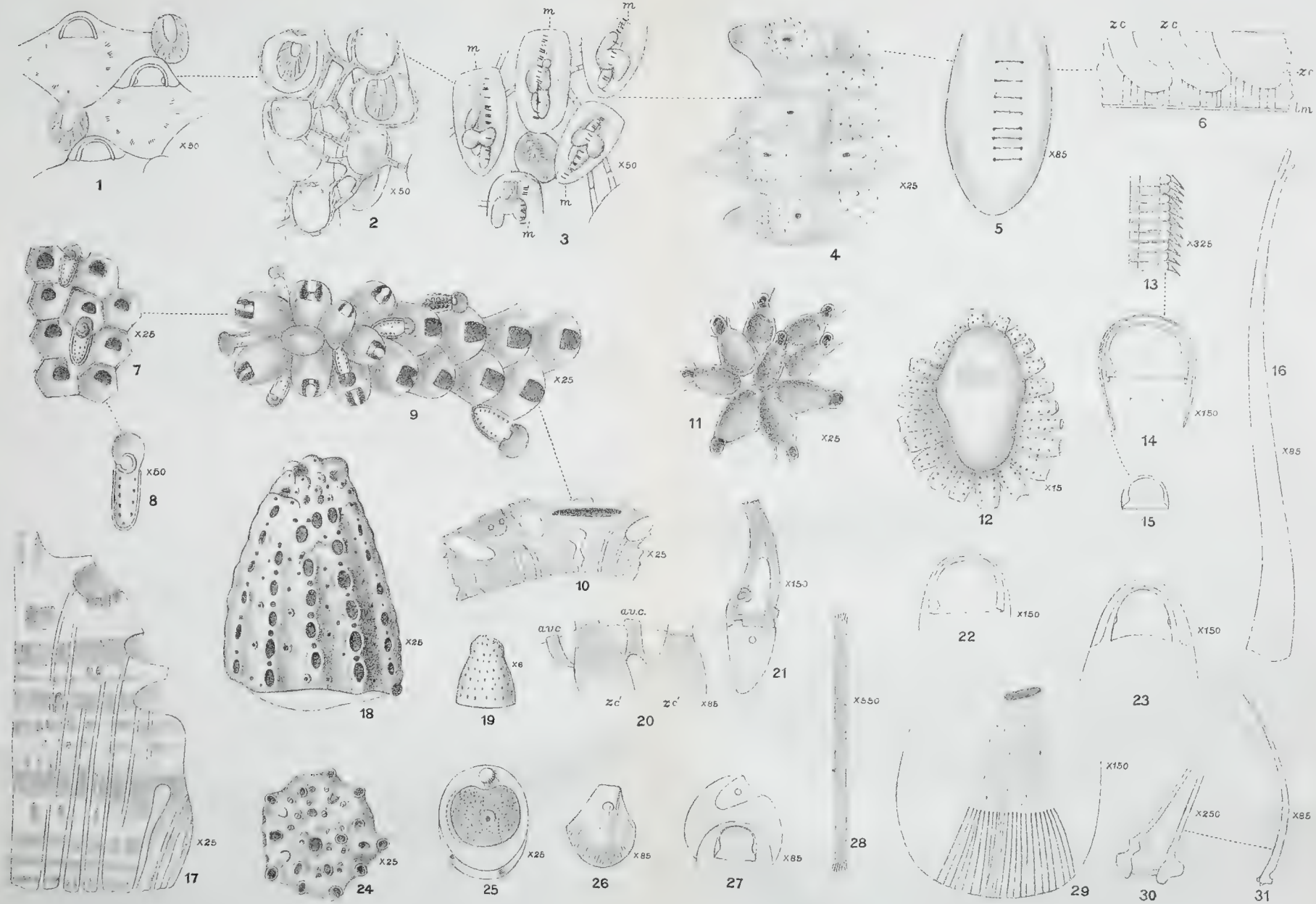

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Fig. 25. *Cupularia canariensis*, Busk, × 25. Ovum in zoœcial chamber. Portion of remains of polypide (*p.*).

26. *Cupularia Lowei*, Busk, × 85. Vibracular chamber, showing the peculiar body ending at the thin circle in the membrane. One bundle of long muscles, as well as the short ones, is shown.

27. Do. do. × 85. Vibracular chamber above the zoœcial chamber.

28. Do. do. × 550. Muscle of vibraculum.

29. Do. do. × 150. Muscles leading to fascia, which is attached to the base of the seta.

30. *Cupularia Johnsoni*, Busk, × 250. Base of seta.

31. Do. do. × 85. Seta.